## WHAT IS CLAIMED:

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A method of detecting one or more characteristics of cells comprising:
 placing one or more cells of interest into an integrated microfluidic patch-clamp array chip providing easy cell trapping; easy optical characterizations; and simple cell loading for multiple single cell analysis.

2. A method of fabricating an integrated patch clamp device comprising:

preparing a mold by making height patterns defining narrow patch channels using deep etching;

adding patterns for wide connection regions;

introducing a settable material into the mold and curing;

detaching the set material from the mole;

placing holes for connection of tubes;

connecting tubes to reservoirs, via said holes, to load cells and/or electrolyte solutions and to apply suction to patch channel.

3. The method of claim 2 further wherein: said mold is constructed from silicon.

4. The method of claim 2 further wherein: said mold is constructed from a ceramic.

5. The method of claim 2 further wherein: said mold is constructed from a metal or metal alloy.

20 6. The method of claim 2 further wherein: said mold is formed using surface micromachining techniques.

7. The method of claim 2 further wherein: said patterns defining the narrow patch channels are formed using deep reactive ion etching; and further patterns are added for wide connection regions using photoresist.

25 8. The method of claim 2 further wherein: said moldable material comprises polydimethylsiloxane (PDMS) and a curing agent.

9. The method of claim 2 further comprising: subsequently bonding a molded device to a thin PDMS layer which was spin cast and then cured onto a glass substrate.

30 10. The method of claim 2 further comprising:

subsequently bonding a molded device to a thin PDMS layer which was spin cast and then first partially cured before bonding onto a glass substrate.

11. A cell trapping device comprising:

a substrate;

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5 a main reservoir able to hold cells in a fluidic medium;

at least one lateral opening in a side of said main reservoir;

at least one trapping channel operatively connected to said at least one lateral opening;

such that a cell in said main reservoir can be selectively immobilized at said lateral opening by negative pressure in said trapping channel.

10 12. The device according to claim 11 further wherein:

said substrate is a three dimensional structure comprising a length, a width and a thickness, said thickness being a smallest dimension; and

said side of said main reservoir is roughly parallel to said thickness.

13. The device according to claim 11 further wherein:

said substrate is a three dimensional structure comprising a length, a width and a thickness, said thickness being a smallest dimension; and

said side of said main reservoir is roughly parallel to said thickness.

14. The device according to claim 11 further comprising:

at least two electrical connections for measuring electrical characteristics between said main reservoir and said trapping channel.

15. The device according to claim 11 further wherein:

said lateral opening has effective dimensions of less than about 3 microns by 3 microns.

16. The device according to claim 11 further comprising:

at least three lateral openings in said main channel, said lateral openings spaced less than 40 microns apart.

17. The device according to claim 16 further wherein:

said lateral openings are electrically connected to operate as independent patch channels.

18. The device according to claim 16 further wherein:

said lateral openings are electrically connected to operate as independent patch channels and are arranged in a horizontal plane allowing multiplexed parallel patch sites that are less than 30 microns apart.

- 19. The device according to claim 17 further wherein:
  - patch channels are in a horizontal plane with multiplexed parallel patch sites having a distance between patch sites of between one hundred  $\mu$ m and one thousand  $\mu$ m.
- 20. The device according to claim 11 further comprising:
- 5 microfluidic features to move substances to appropriate positions of said device.
  - 21. A multiple cell trapping device comprising:
    - a substrate;
    - a main reservoir able to hold cells in a fluidic medium running parallel to the largest dimensions of said substrate;
- a plurality of lateral openings in sides of said main reservoir, at least some of said openings operatively connected to a plurality of trapping channels;
  - a microfluidic input for introducing cells in a fluid to said main reservoir;
  - one or more microfluidic trapping connections for applying negative pressure to said lateral openings;
- such that cells in said main reservoir can be selectively immobilized at said lateral openings.
  - 22. The device according to claim 21 further wherein:
    - said substrate is formed of an elastomer;
    - said lateral openings have a cross section less than about 3 microns by 3 microns; and said lateral openings are operatively connected to trapping channels with cross sections less than about 3 microns by 3 microns.
  - 23. A multiple cell trapping device comprising:
    - a substrate;

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- means for holding cells in fluid suspension in a main channel, said means running parallel to the largest dimensions of said substrate;
- lateral cell trapping means formed in said substrate and operatively connected to said means for holding cells in fluid suspension;
  - means for applying negative pressure to said lateral cell trapping means in order to selectively immobilize cells at said lateral trapping means.
  - 24. The device according to claim 23 further comprising:
- means for measuring electrical properties between said means for holding cells and said lateral trapping means.

25. A device allowing fast application and removal of reagents from a sample area employing microfluidic delivery comprising:

a sample area;

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a main channel; and

5 one or more an injection channels;

wherein in operation, a generally constant fluid flow is supplied to the main channel and said injection channel is being driven by a pressure as a function of time.

- 26. The device according to claim 23 further wherein said sample area may contain trapped cells, adherent cells on the device substrate, and/or other reaction loci such as microarray spots.
- 10 27. The device according to claim 23 further wherein said device can be constructed using very simple fabrication by elastomer micromolding.
  - 28. The device according to claim 23 further wherein said main channel and said injection channels have a lateral configuration where all the channels are in roughly horizontal planes.
  - 29. The device according to claim 23 further wherein: said one or more injection channels comprise an array of a number of injection channels.
  - 30. The device according to claim 23 further comprising upstream of the injection channel, a microfluidic mixer with an inlet connected a reagent reservoir and an inlet connected to a stock solution.
  - 31. A device for connecting a microfluidic assay chip to external electrical and fluidic systems comprising:
- an arrangement of hollow cylindrical electrical conductors connected to a plurality of electrical connectors.
  - 32. The device according to claim 31 further wherein: said conductors are arranged so as to operatively mate with fluidic connections on said assay chip.
  - 33. The device according to claim 31 further wherein:
- said conductors are arranged so as to operatively mate with fluidic couplings to an external fluidic system.
  - 34. The device according to claim 31 further wherein: said electrical connectors are arranged so as to operatively mate with an electrical socket of an electronic testing system.
- 30 35. The device according to claim 31 further wherein:

said hollow cylindrical electrical conductors are comprised of Ag/AgCl.

- 36. The device according to claim 31 further wherein: said hollow cylindrical electrical conductors are comprised of a metal/metal-chloride alloy.
- 37. The device according to claim 31 further wherein: said hollow cylindrical electrical conductors are comprised of a metal/metal-chloride alloy.
  - 38. The device according to claim 31 further wherein: said hollow cylindrical electrical conductors are comprised of a conducting polymer.
- 39. The device according to claim 31 further wherein:said hollow cylindrical electrical conductors are comprised of a metal.
  - 40. The device according to claim 31 further wherein: said hollow cylindrical electrical conductors are comprised of a conducting ceramic.
- 41. The device according to claim 31 further wherein:
  said hollow cylindrical electrical conductors can be used with microfluidic systems to serve as both a
  fluidic interface and an electrical interface for microfluidic chips.
  - 42. The device according to claim 31 further wherein as fluid flows through said hollow electrodes, electrical and fluidic connections are established.
  - 43. The device according to claim 31 further wherein said hollow electrodes are reusable with multiple microfluidic chips.

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